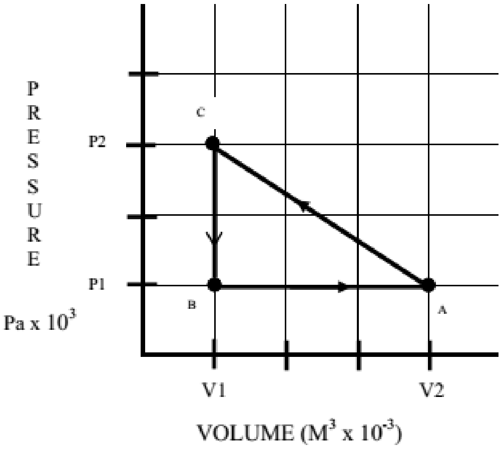
HW 5 PV Diagrams

1. One mole of ideal monatomic gas, initially at point A at a pressure of 200.0 E3 Newtons per meter and a volume of 100.0 E-3 meter cubed, is taken through a 3-process cycle. Cv = (3/2)R and Cp = (5/2)R where R = 8.31 J/(mole*K). What is the temperature at Points A, B, and C?



$$T = \frac{PV}{nR} = \frac{PV}{1mol(8.315j/mol/K)}$$

$$T_a = \frac{200,000Pa(0.1m^3)}{8.315J/K} = \boxed{2400K}$$

$$T_b = \frac{200,000Pa(0.025m^3)}{8.315J/K} = \boxed{600K}$$

$$T_c = \frac{600,000Pa(0.025m^3)}{8.315J/K} = \boxed{1800K}$$

$$\triangle U_{ac} = \frac{3}{2}(1mol)(8.315J/mol/K)(-600K) = \boxed{-7500J}$$

$$W_{ac} = \frac{1}{2}(0.075m^3)(400,000Pa) + (0.075m^3)(200,000Pa) = \boxed{30000J}$$

$$Q_{ac} = \boxed{-37500J}$$

CB

$$\triangle U_{cb} = \frac{3}{2}(1mol)(8.315J/mol/K)(-1200K) = \boxed{-15000J}$$

$$W_{cb} = (0m^3)(600,000Pa) = \boxed{0J}$$

$$Q_{cb} = \boxed{-15000J}$$

BA

$$\triangle U_{ba} = \frac{3}{2}(1mol)(8.315J/mol/K)(1800K) = \boxed{22500J}$$

$$W_{ba} = (0.075m^3)(200,000Pa) = \boxed{-15000J}$$

$$Q_{ba} = \boxed{37500J}$$

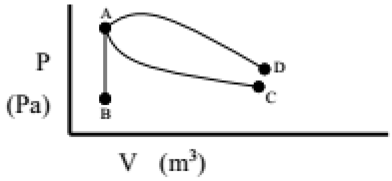
ACBA

$$\triangle U_{acba} = \frac{3}{2}(1mol)(8.315J/mol/K)(0K) = \boxed{0J}$$

$$W_{acba} = \frac{1}{2}(0.075m^3)(400,000Pa) = \boxed{15000J}$$

$$Q_{ac} = \boxed{-15000J}$$

Random Questions.



In which process is the LEAST work done?

$\triangle V = 0$ So $\boxed{AB}$

Name process AB.

AB is $\boxed{isochoric}$

In which process is the MOST work done?

$\boxed{AD}$ involves the most work done as the pressure is greater at every point and the change in volume is greater.

Which process is the closest representation of an ISOTHERMAL process?

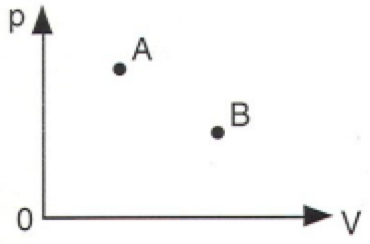
$\boxed{AC}$ is closer to isothermal because in an isothermal process, pressure varies inversely with volume.

How much work is done if an ideal gas is initially at pressure P and volume V and allowed to expand ISOBARICALLY to three times it original volume?

$P\triangle V = (3V_o - V_o)P = \boxed{-2V_oP}$

A system undergoes an adiabatic process and its internal energy increases by 20 joules. Which of the following is true about the heat exchanged with the system and the work done on or by the system?

$\boxed{A}$ No heat is added; 20 joules of work are done on the system. This is because an adiabatic process involves no heat transfer and work done to the system increases its energy.



Consider the points A and B on the p-V diagram shown above. An ideal monatomic gas is carried from a state of thermal equilibrium at A to one at B over a path not specified. If one knows the pressure, volume and temperature at both A and B, it is then possible to calcu- late the

$\boxed{B}$ gain or loss of internal energy of the gas. This is so because internal energy is a state function, the change of which can be determined by $\triangle U = \frac{3}{2}nR\triangle T$ (n can be determined with the ideal gas law). Work and heat are process functions though: if we don't have the path on our graph, we cannot calculate work (area under an unknown curve) and therefore not heat either (change in internal energy minus an unknown work).

A certain quantity of an ideal gas is compressed to half its initial volume. The process may be isobaric, adiabatic, or isothermal. The greatest amount of mechanical work is required if the process is

$\boxed{A}$ adiabatic. This is so because, as one compresses the gas adiabatically, the pressure increases more greatly than if isothermally, because the gas has a higher temperature along with the same reduced volume.